
Issues Related to the Strategic Fuel Reserve

**Presented at the Committee Workshop on
Strategic Fuel reserve and Alternatives to Dampen
Price Volatility**

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April 24-25, 2003**

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- Price Volatility
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- Role of Inventories
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- Economic Evaluation of the SFR
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All data contained herein were obtained from public sources. The accuracy of the analysis is only as accurate as the data permit.

Price Volatility

California Gasoline Price Volatility Factors

- Refinery capacity is tight with limited ability to expand capacity
- The demand for gasoline is highly inelastic, such that a disruption in supply from refinery outages creates scarcity, causing prices to rise sharply to clear the market
- Refining costs are high to produce CARB RFG
- It is costly to import compliant gasoline or components from outside California
- Future regulations suggest the premium will grow and become even more volatile.

CA Gasoline Prices are higher and more volatile than rest of US

Historical Volatility

Average Per Month Volatility of Spot Gasoline Prices (%)

	NY RFG	USGC RFG	LA RFG
1996	5	5	8
1997	6	5	9
1998	6	6	7
1999	7	8	15
2000	8	10	10
2001	12	12	14
2002	6	8	7
1996-2002	8	8	11

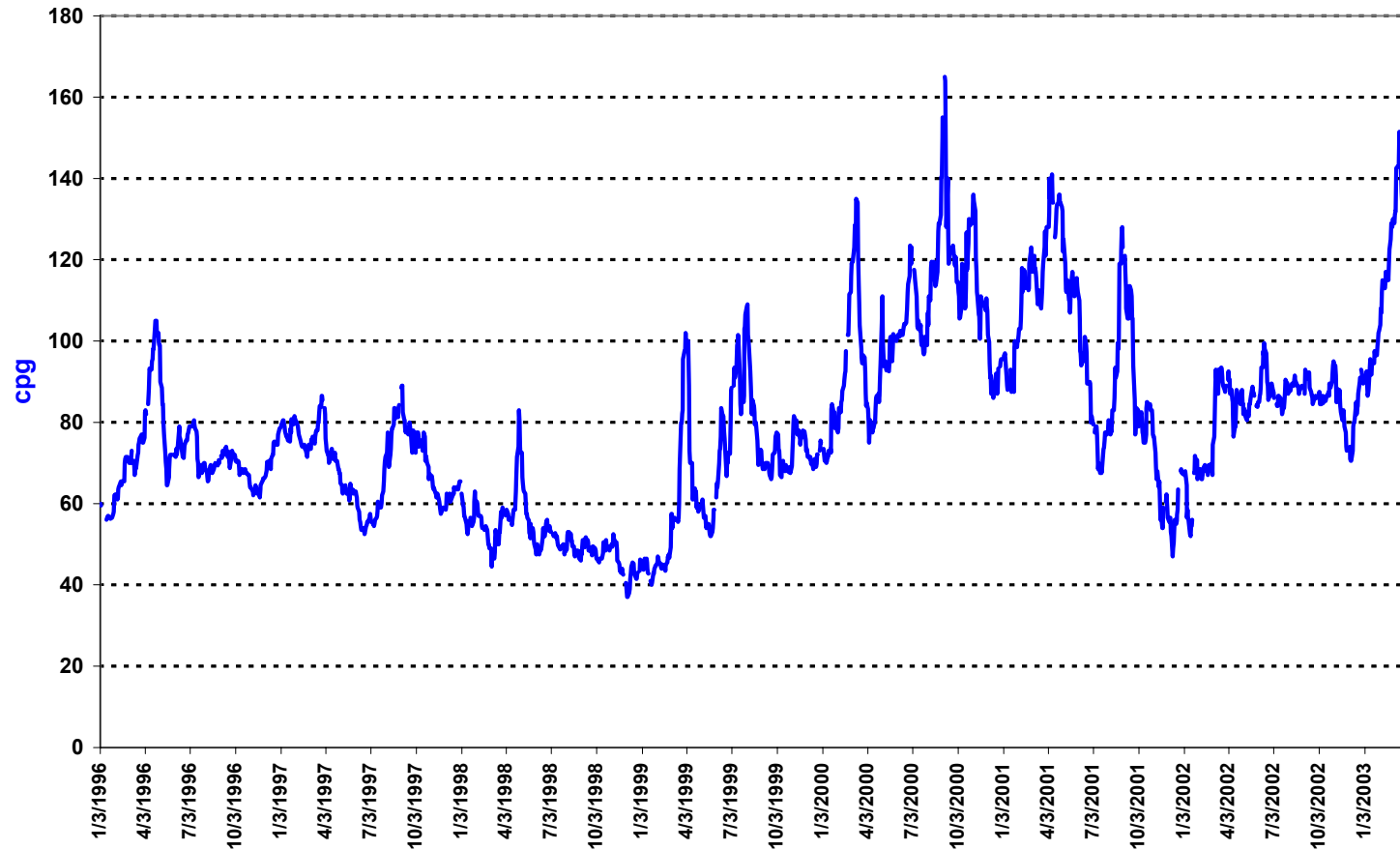
Historical Volatility

Average Per Month Volatility of Retail Gasoline Prices (%)

	US RFG	LA RFG
1996	5	11
1997	4	7
1998	4	8
1999	9	18
2000	10	12
2001	15	14
2002	9	10
1996-2002	9	13

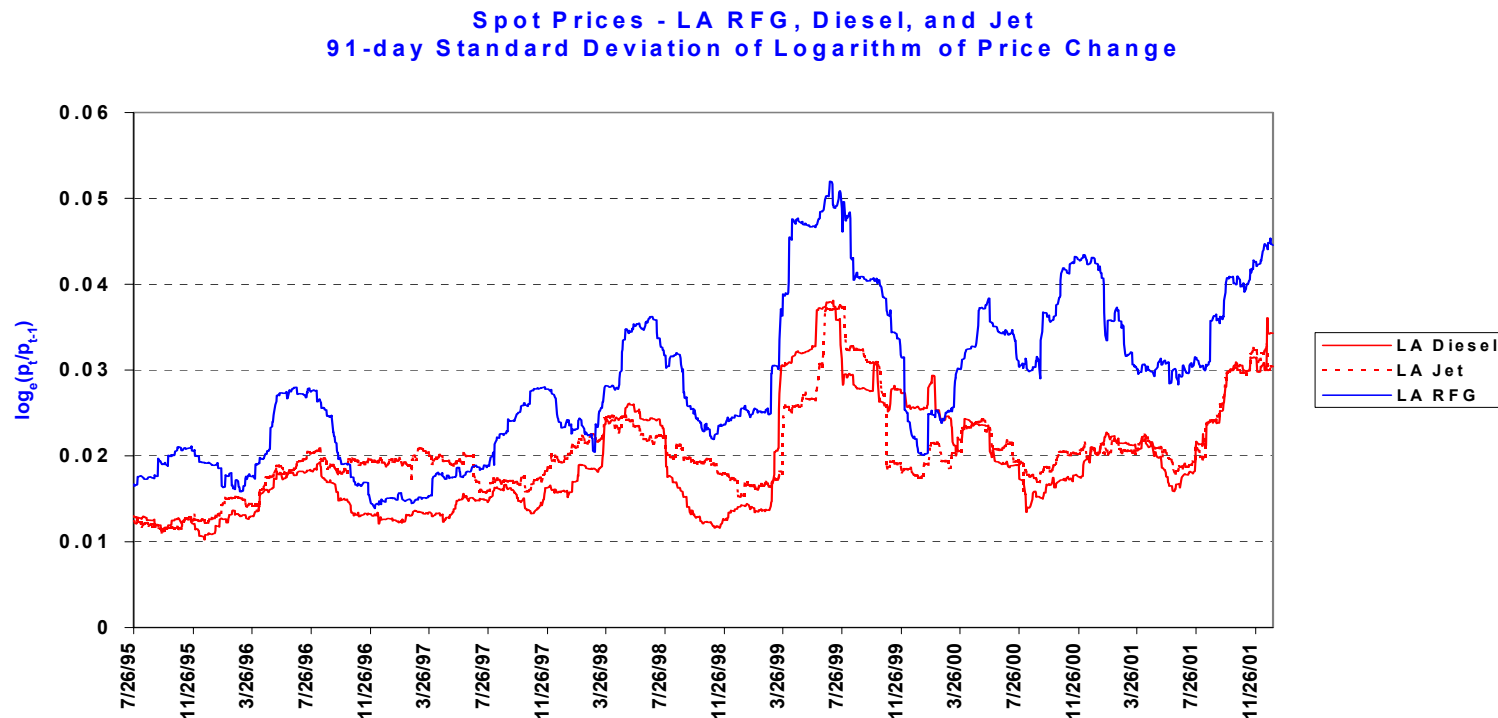
California's Gasoline Price

Los Angeles Spot Reformulated Regular Gasoline



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Price Volatility of Products

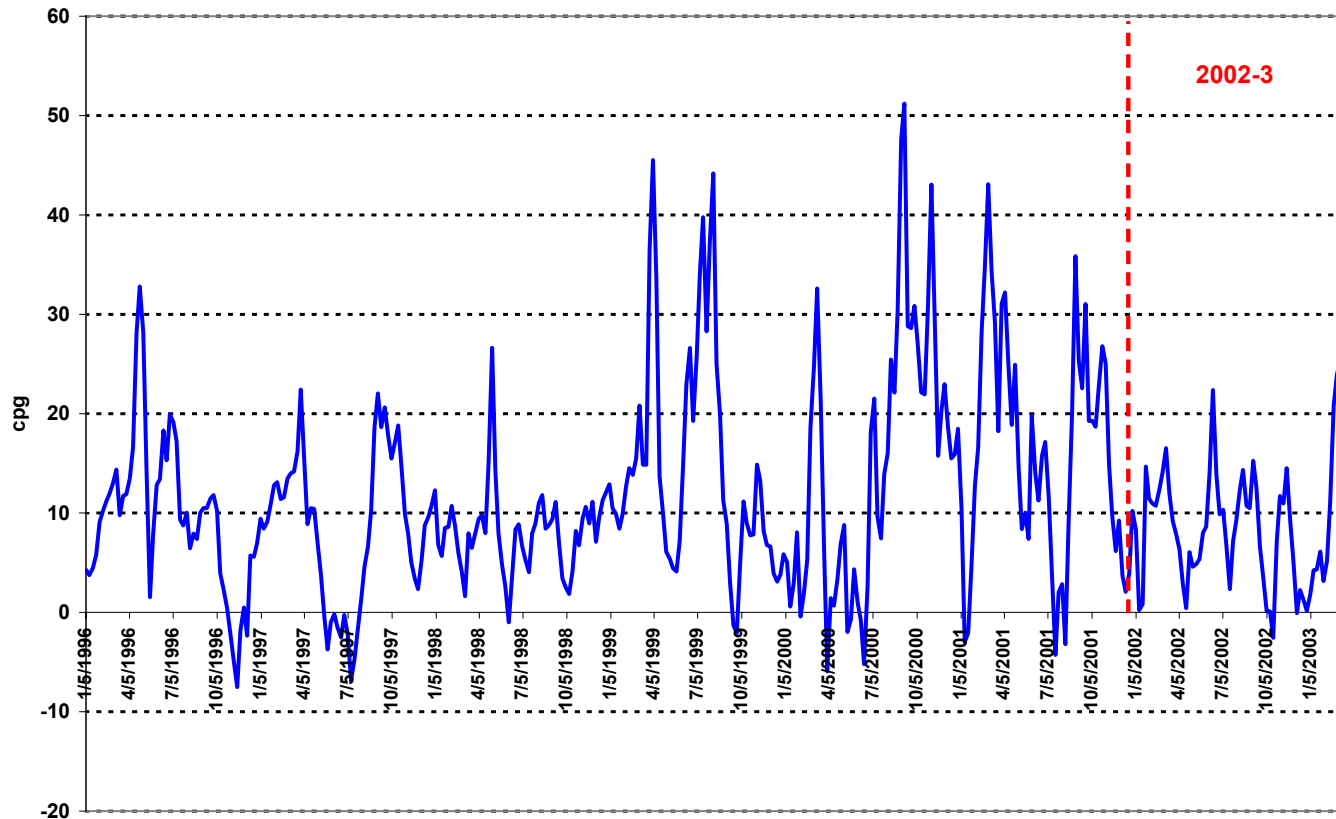


California Gasoline More Volatile than other petroleum products

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California Spot Price Spikes (corrected for crude price costs)

Los Angeles Spot less US Gulf Coast Spot Gasoline Prices

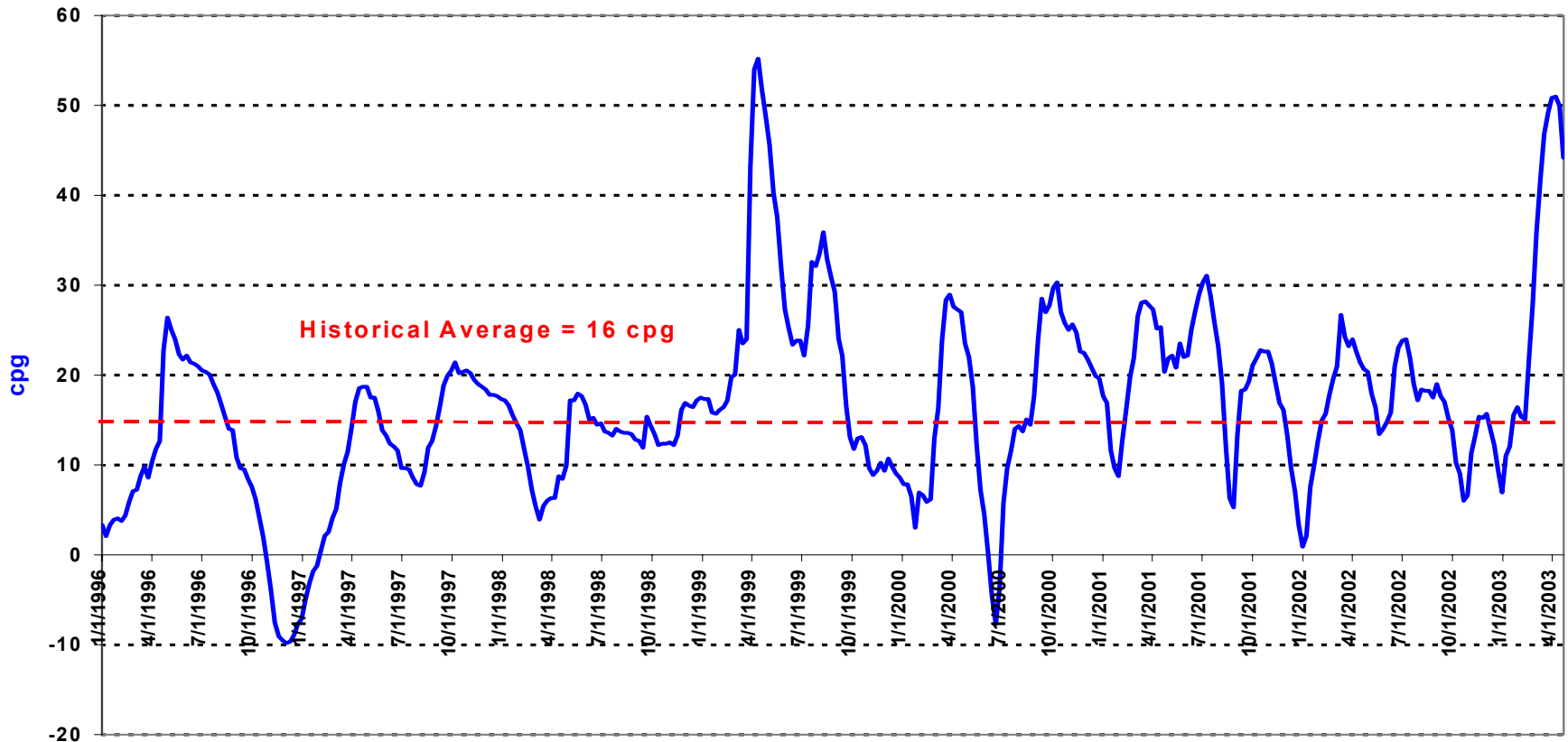


Price Spikes Recently are less Dramatic than Prior to 2002

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California Retail Price Spikes

Retail Reformulated Gasoline Prices
California less Other US



Recent Price Spike More Dramatic than those in 2000-02

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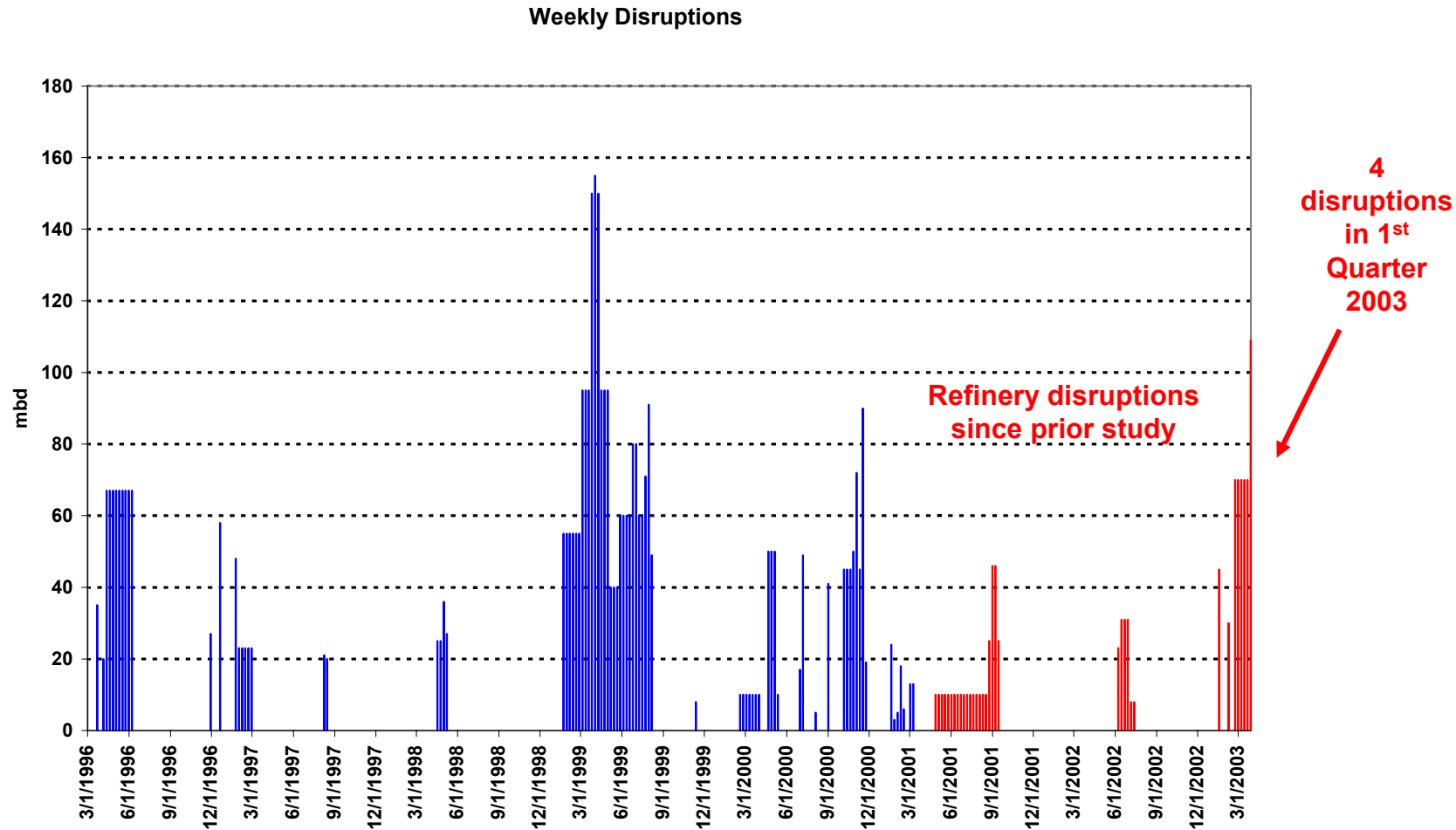
Price Volatility Conclusions

- Gasoline prices are higher and more volatile in California than in the rest of the country.
- Price volatility increased from 1996-2001, then decreased.
- Price volatility In California has increased relative to the Gulf Coast and NY.
- Price Volatility In California Is usually higher than in the Gulf Coast and in NY.
- Price spikes at wholesale (spot prices) not as dramatic as in 1999-2001
- Price spikes at retail as dramatic as in 1999.

Refinery Disruptions

The underlying data for the disruption section have been provided to me by the US DOE and derived from third party sources and should not be quoted without my knowledge. The data have not been corroborated by the companies involved. Some, but not all, of the incidents have been verified in the public press. I updated the material after March 2001.

Occurrence of Refinery Disruptions



Characteristics of Refinery Disruptions

	Chance of Occurrence	Average Size MBD		Average Length Weeks	
Case	Probability	Mean	Std. Dev	Mean	Std. Dev
Base Assumptions Disruptions occur at historical frequency, size, duration	.017	21	15	2.7	3.9
Disruptions occur at historical frequency, size, duration excluding the year 1999	.014	19	14	1.8	1.9

Refinery Disruption Findings

- Refinery disruptions have occurred once a month on average since 1996
- Refinery disruptions average 20 MBD with several larger disruptions
- Refinery disruptions average 3 weeks with several longer episodes
- Size and Duration of Refinery Disruptions Are Not Correlated
- Disruption effect is generally short-lived; some last 6-8 weeks
- Multiple refinery disruptions can be ongoing simultaneously
- Refinery disruptions have an immediate impact on spot prices
- Not all disruptions lead to price spikes
- Planned turnarounds do not affect prices unless coincident with a disruption
- Refinery disruption in either part of California affects all of California
- Price spikes are not transmitted to other areas outside of PADD V.
- Refiners respond quickly to a disruption, but distance is a barrier

Economic Evaluation of the SFR

Assumptions Underlying Analysis

- The SFR can truncate price spikes in a timely manner
- Auction mechanism is non-discriminatory
- The SFR does not crowd out private inventories
- The SFR does not discourage forward liquidity

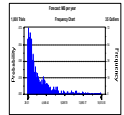
Schematic of Benefits Calculation

Evaluate Market Impacts of

Disruptions Without and With Option

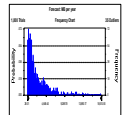
Compare Options Using Criteria

Determine Pattern of Disruptions



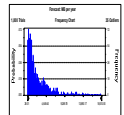
Chance of Disruption

x



Size of Disruption

x



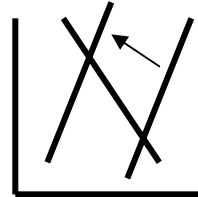
Length of Disruption

=

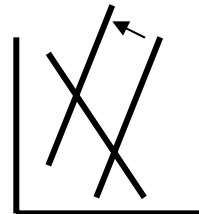
Number of Barrels Subject to Disruption



Without Option



With Option



Change in Consumer Gasoline Bill

or

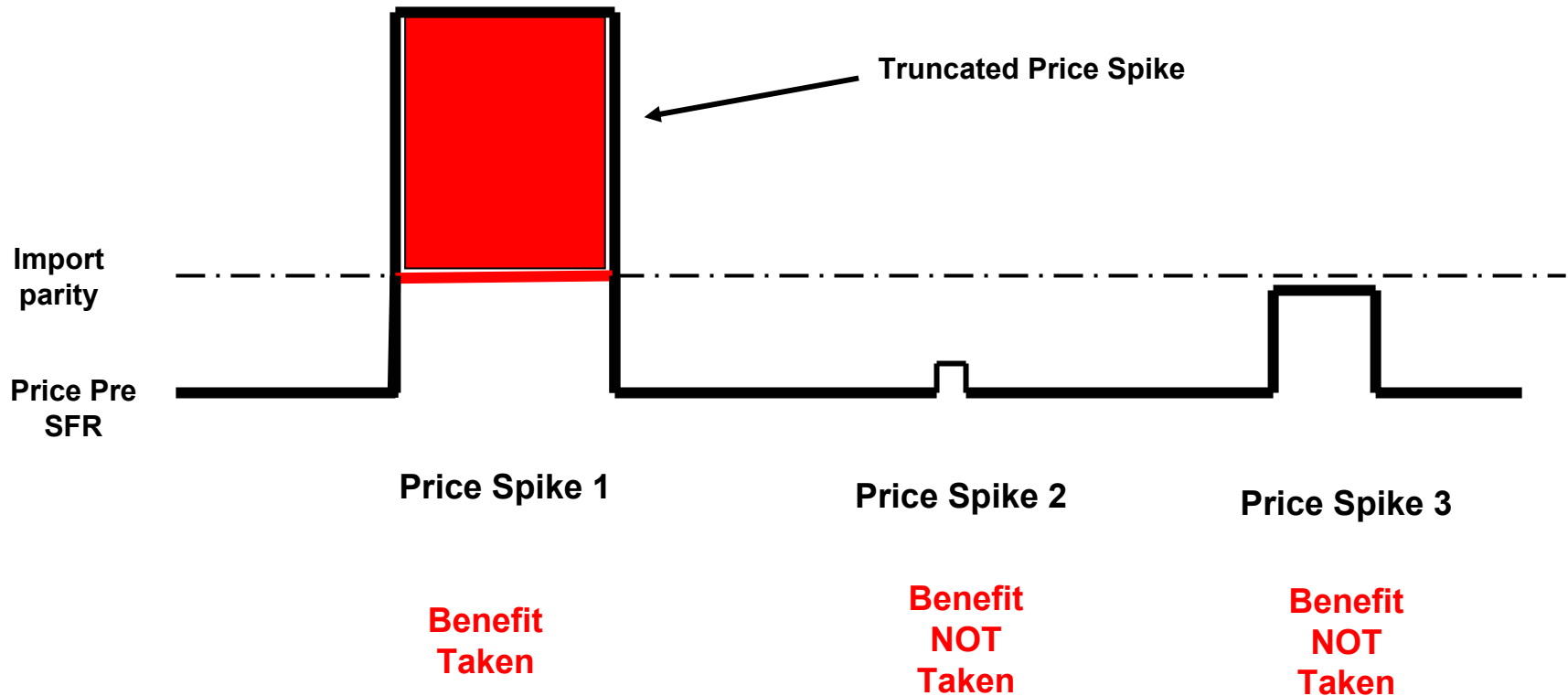
Change in Consumer Surplus

or

Change in Total Welfare

Perform Sensitivity Analysis

Schematic of a Stylized Price Path and Benefits Calculated



Approaches to Calculating Price Impacts

- Lack of full demand/supply model and noisy weekly data at industry level does not permit detailed econometric modeling
- Approaches used to gauge impacts
 - (1) Demand and supply elasticities from literature
 - (2) Verification of elasticities from actual episodes
 - (3) Simulation impacts model

Gasoline Demand Price Elasticities

Surveys of Studies	Mean	Median	Range
Dahl (1995)	-.19	-.10	+. 03 to -2.13
Dahl and Sterner (1991)	-.19	-.18	-.08 to -.41***
Dahl (1986) **	-.15*	-.125*	-.01 to -.52
Post-1995 Individual Studies	Mean	Median	Range
Verleger (2002) Senate Testimony	-.1		
FTC (2001) Midwest Gasoline Investigation	-.2		-.1 to -.4
Perry (2001)	-.05		
WSPA (2001) (PIRINC study)	-.05		
Borenstein (2000)	-.15		
Kayser (2000)	-.23		
API (Porter) (1996)	-.19		
Haughton & Sarkar (1996)	-.15		-.12 to -.17
8 Individual Studies	-.14	-.15	
Std. Deviation of 8 Individual Studies	.07		

*Calculated by this author.

** Estimate is for monthly and quarterly models. Dahl cited -.29 for yearly models.

***Range of means.

The Literature suggests a Wide Range of Demand Price Elasticities.

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Empirical Estimates of the Combined Elasticity

Outages	Size (mbd)	Inventory Character	Implied Elasticity
01/24/97	25	High (Winter)	-.200
08/08/1997	21	Low	-.108
04/17/1998	28	Normal	-.137
07/23/1999	31/51/49	Low	-.125
		Average	-.143

Economic Benefits

Lower Consumer Gasoline Bill with SFR versus Without SFR			
Assumed Combined Elasticity:	- 0.10	- 0.15 (Best Estimate)	- 0.20
Base Case Assumptions Historical disruption frequency, size, duration \$1.50 retail price before disruptions 10 cpg incremental spot price to replenish SFR No price rise during period of high inventories	\$687 MM/yr	\$398 MM/yr	\$261 MM/y
Sensitivities - Base Case Assumptions Except:			
\$1.00 retail price		\$220 MM/yr	
\$2.00 retail price		\$607 MM/yr	
15 cpg incremental spot price		\$339 MM/yr	
5 cpg incremental spot price		\$498 MM/yr	
Disruptions excluding the year 1999		\$169 MM/yr	
Rumored disruptions included		\$255 MM/yr	

Economic Benefits

Increase in Consumer Surplus with SFR versus Without SFR			
Assumed Elasticity:	- 0.10	- 0.15 (Best Estimate)	- 0.20
Base Case Assumptions Historical disruption frequency, size, duration \$1.50 retail price before disruptions 10 cpg incremental spot price to replenish SFR No price rise during period of high inventories	\$745 MM/yr	\$401 MM/yr	\$269 MM/yr
Sensitivities - Base Case Assumptions Except:			
\$1.00 retail price		\$200 MM/yr	
\$2.00 retail price		\$632 MM/yr	
15 cpg incremental spot price		\$310 MM/yr	
5 cpg incremental spot price		\$535 MM/yr	
Disruptions excluding the year 1999		\$166 MM/yr	
Rumored disruptions included		\$250 MM/yr	

Total Economic Benefits **(Millions of Dollars per year)**

- Truncation of Large Price Spikes: \$170-400
- Lower average gasoline prices: \$150-250
(includes reduction of chronic shortage
and small spikes cited in Stillwater Report)
- Total \$320-650
(Roughly 1-3% of the annual
California consumer gasoline bill)

Components of the California Consumer Gasoline Bill (2002)

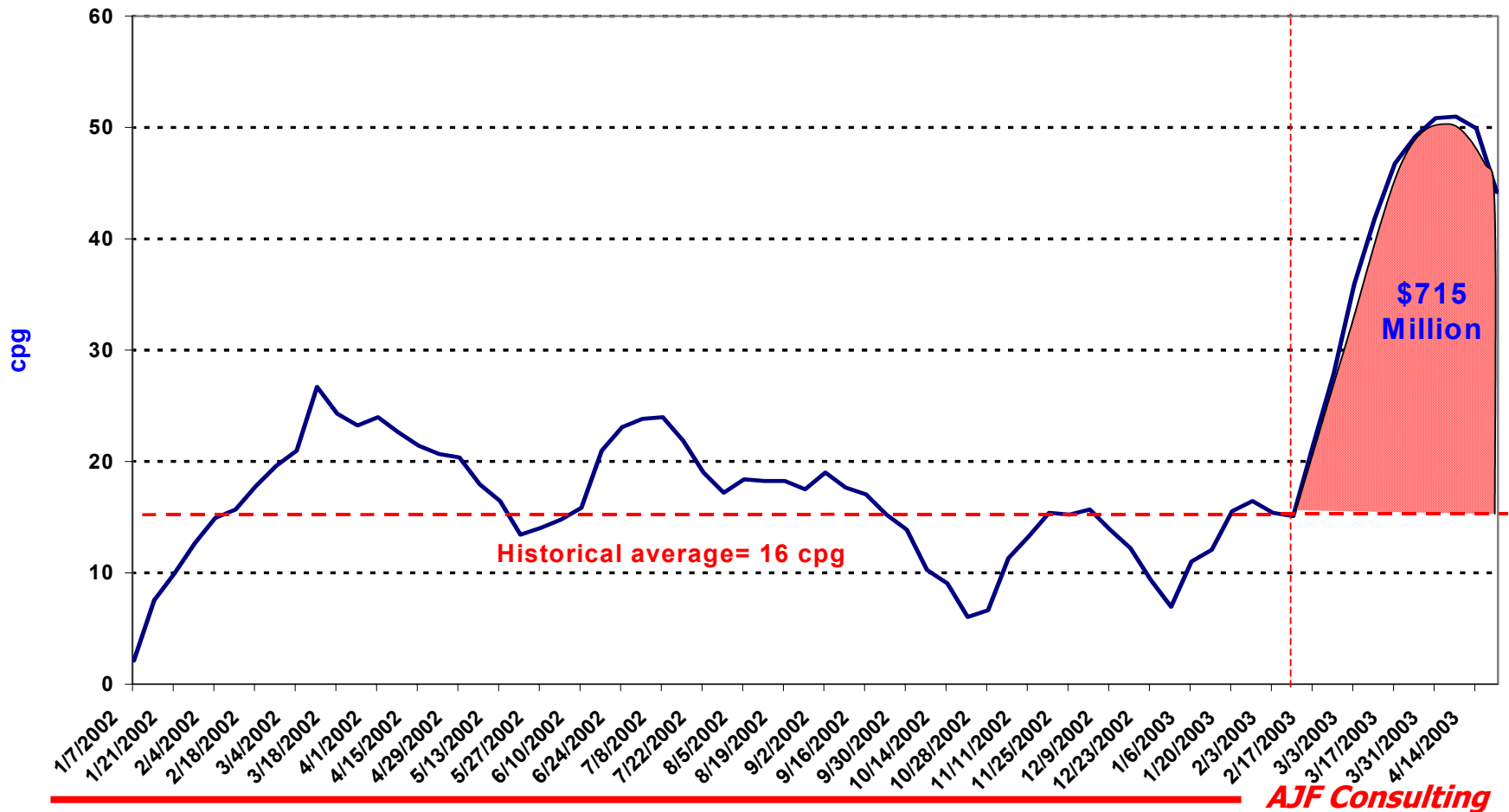
Federal Excise Tax	\$2.7 Billion
State Excise Tax	2.6 Billion
State Sales Tax	1.6 Billion
Crude Cost	8.1 Billion
Refiners costs and margin	5.9 Billion
Dealer costs and margin	.8 Billion
Total Consumer Cost	\$21.8 Billion

Note: Average California retail price in 2002 was \$1.56

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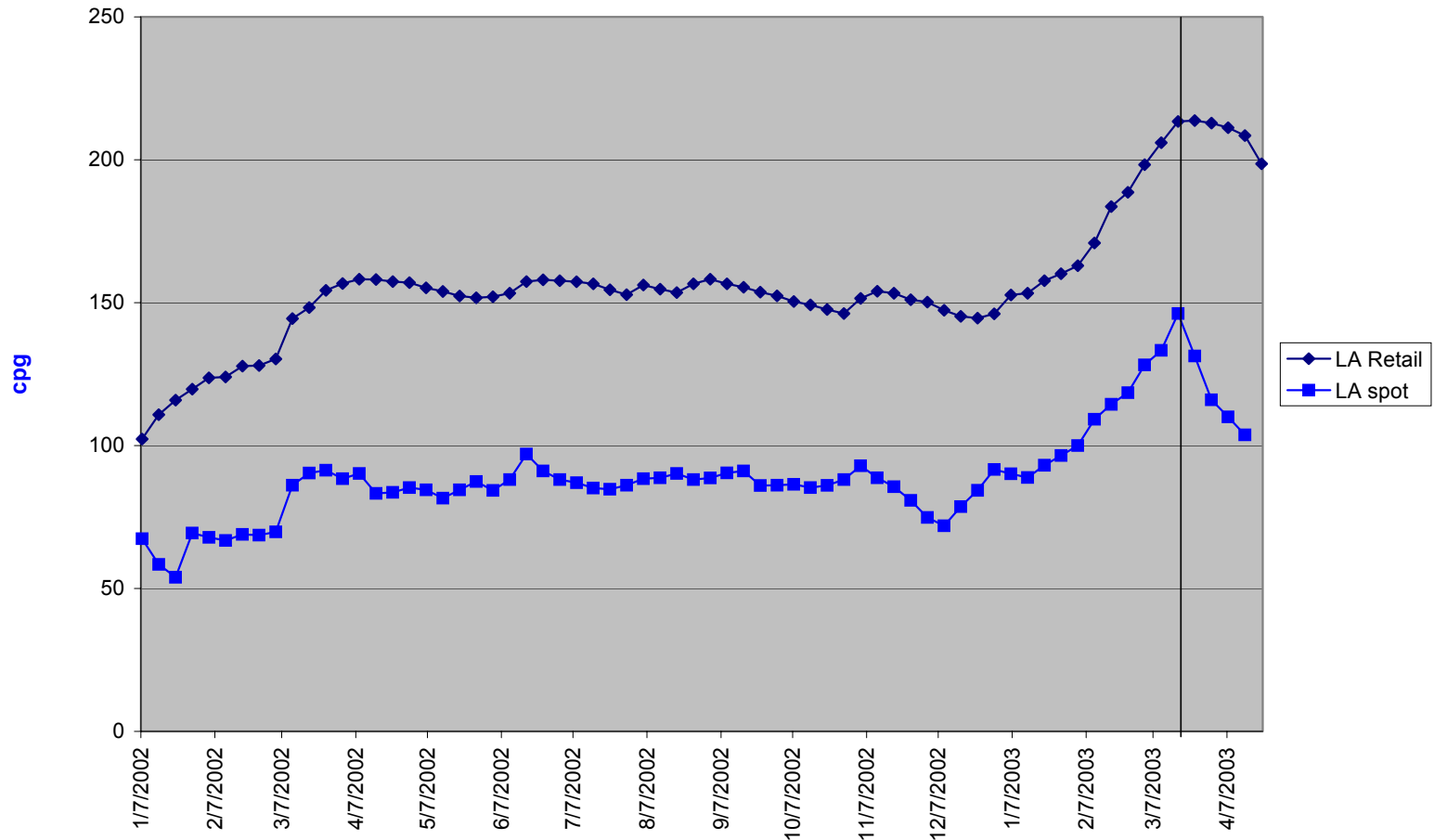
Recent Rise in California Gasoline Bill (relative to the rest of the US)

Retail Reformulated Gasoline Prices
California less Other US



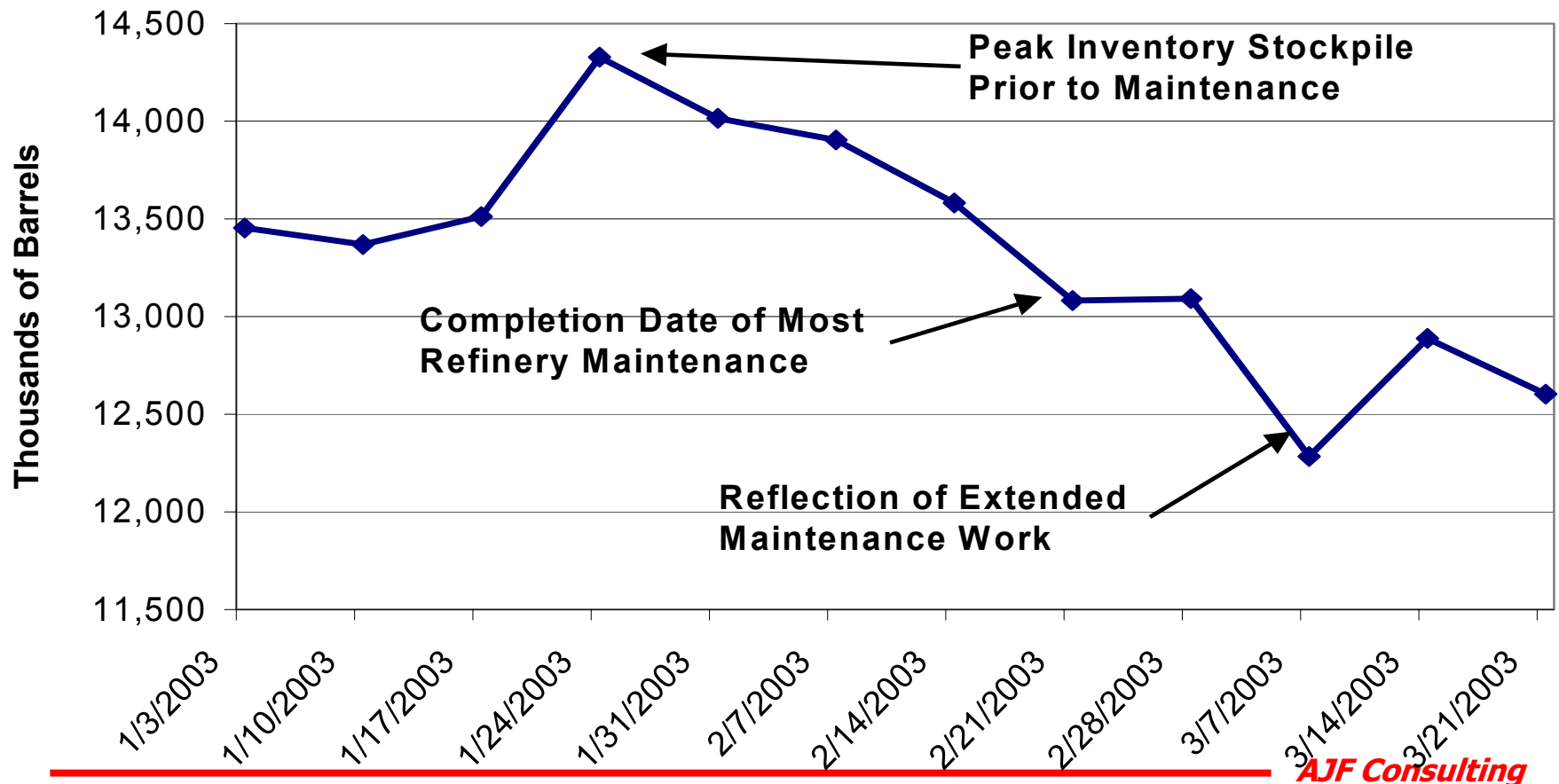
Lagged Response of Retail Prices to Spot Price Fall

Los Angeles Retail vs Spot Gasoline Prices

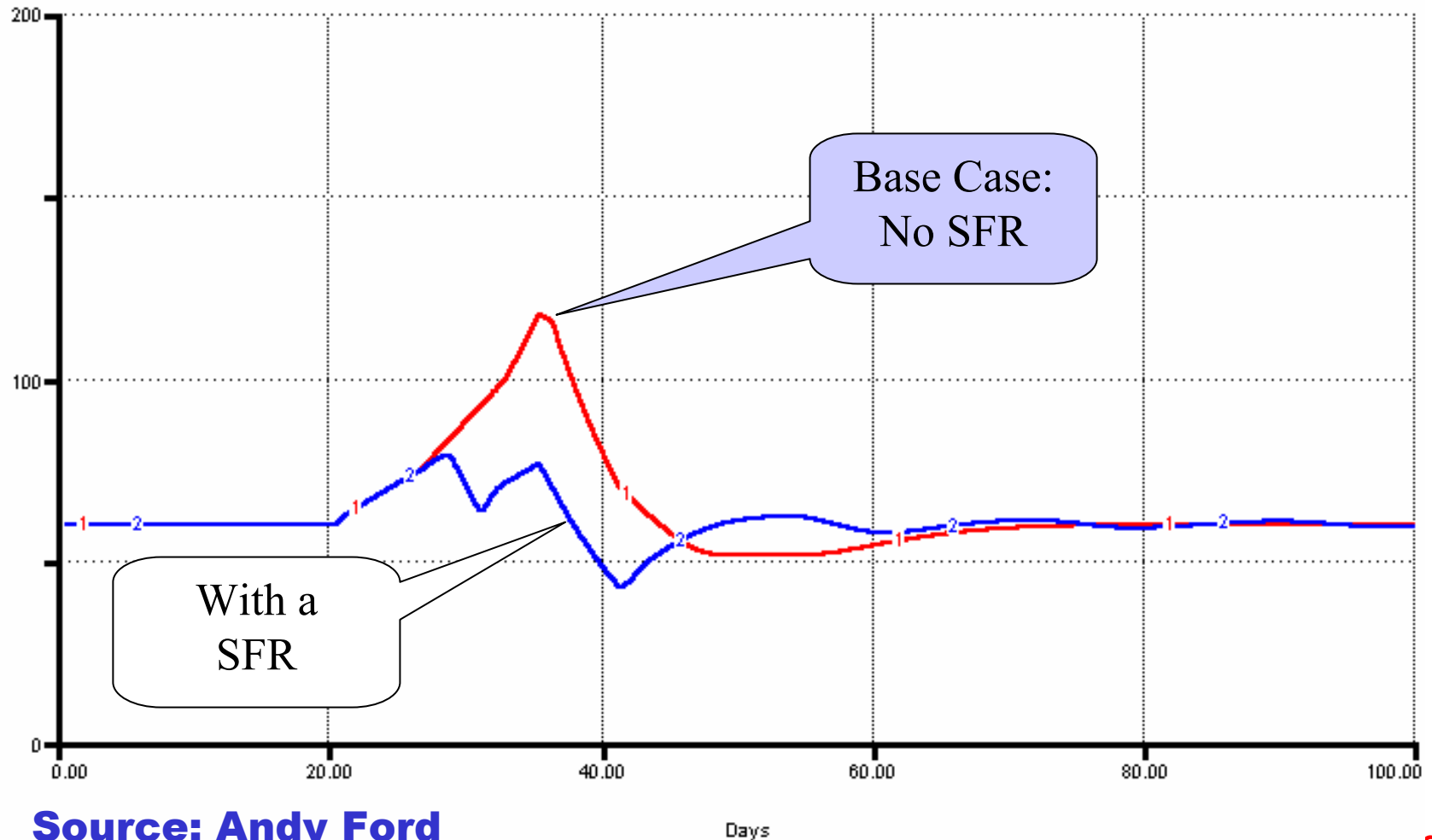


First Quarter 2003 Inventory Behavior

Reformulated Gasoline & Blendstocks California Inventories

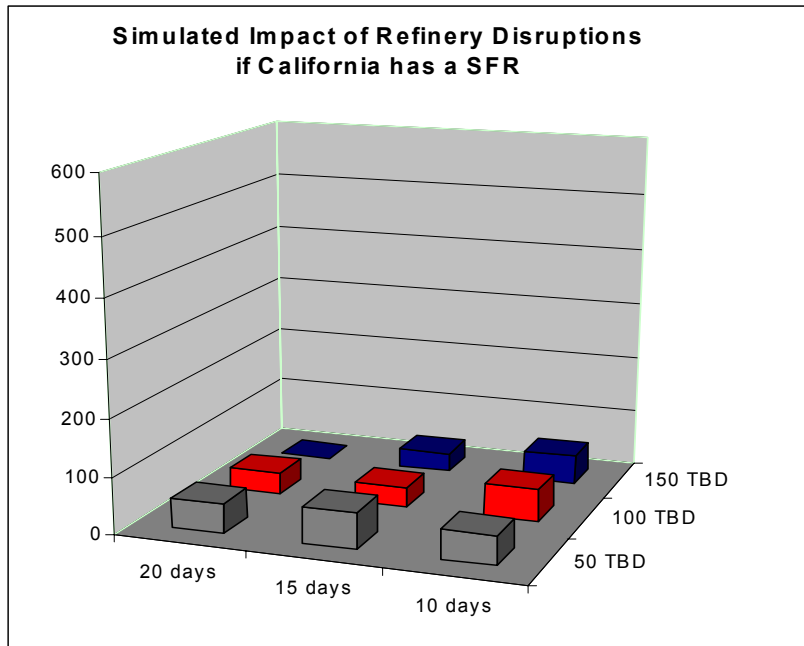


Spot Price Comparison



Source: Andy Ford

Economic Benefits



•Independent modeling by Andy Ford has found

- Large benefits from prevention of price spikes from prolonged outages
- Possible negative benefits from short, small outages
- Overall effect confirms order of magnitude benefits from earlier study
- Model does not include benefits from establishing global arbitrage

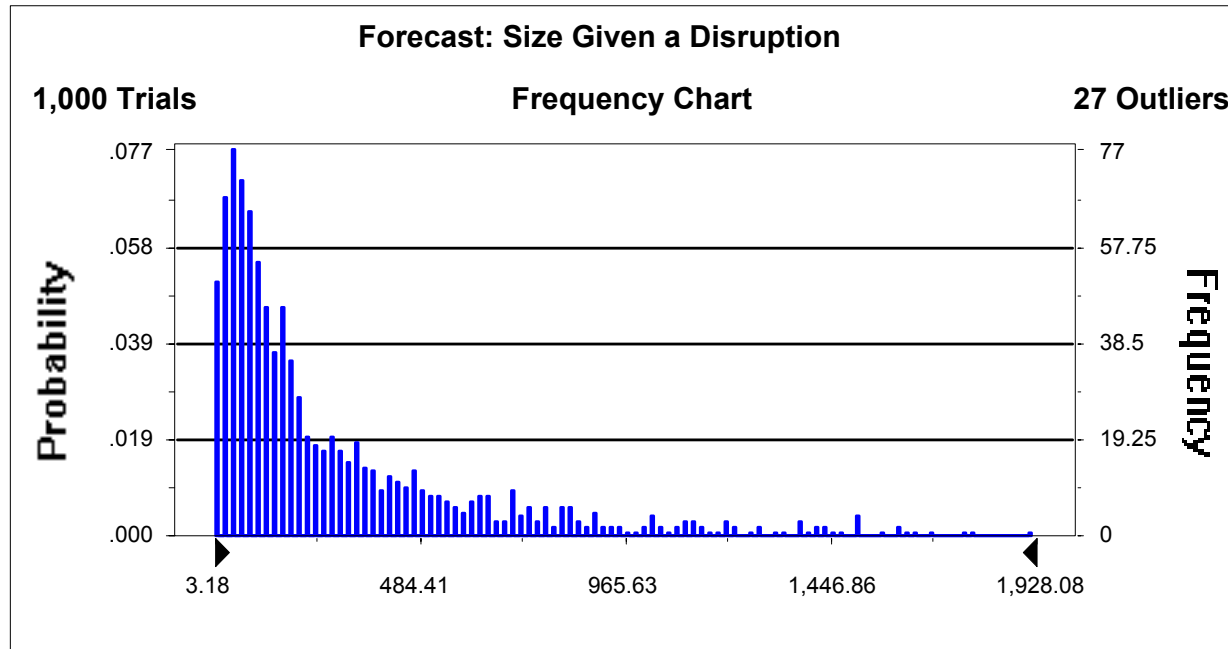
Source: Andy Ford

“Optimal” Size of the SFR

How To Size The Strategic Fuel Reserve?

- Legislative Prescription = ~ 2300 mb
- Assume one refinery suffers a 20 disruption (average) for 2.7 weeks (19 days) = 380 mb
- Cover maximum disruption in 1999 = ? mb
- Use Monte Carlo solution \Rightarrow

Expected Size of a Disruption (Impact x Length)

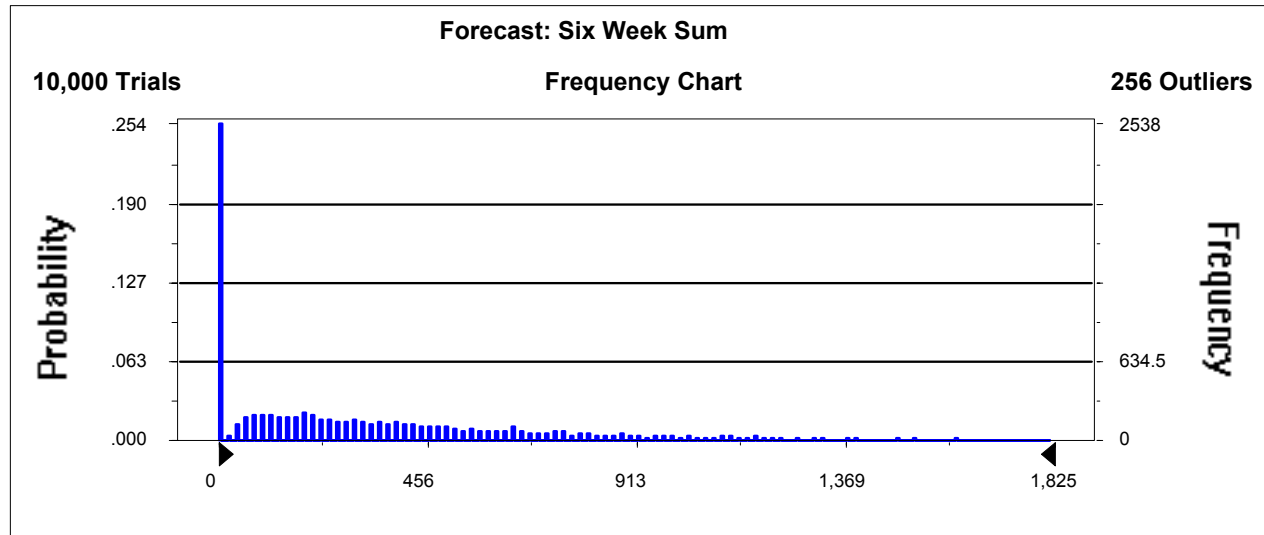


Distribution of Size of Disruption - MB

Expected Value (mean)	385
80TH percentile	525
90th percentile	870
95th-percentile	1380

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Disrupted Barrels During A Six-Week Period



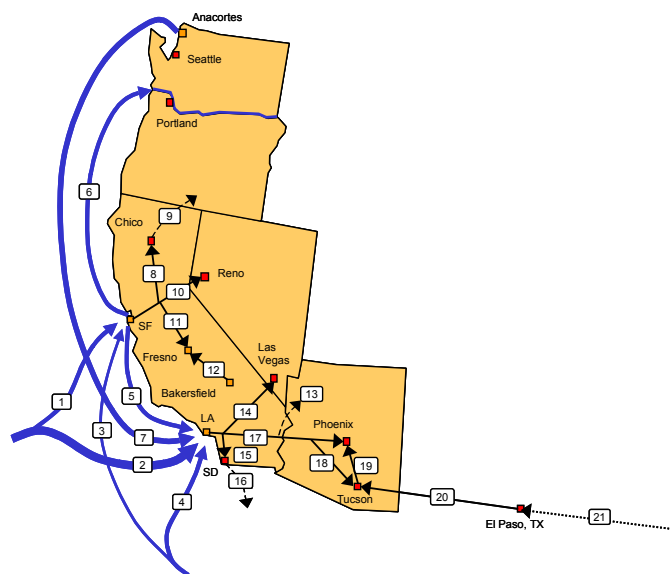
Percentile	M Barrels
Mean (expected value)	431
80 th	737
90 th	1,114

Conclusions

- For measuring short-term price impacts, a reasonable range of price elasticities (combining both demand and supply effects) is $-.10$ to $-.20$ with the best estimate at $-.15$.
- The potential economic benefit, if measured by the avoidance of increased consumer costs or increased consumer surplus, is about \$400 Million per year under average disruption conditions (about 1.5-2% of the consumer gasoline bill). The calculated benefits range from \$250 to \$700 million under various alternative assumptions.
- The economic benefits are an order of magnitude larger than the costs determined in the Stillwater report.
- The “optimal” size of the SFR, given the average disruption conditions that existed in the 1996-2001 period, is significantly less than that prescribed by the Legislature.



“California is an Island”
Peter Heylen, Cartographer, 1703



“California is an Island”
Greg Haggquist, Stillwater Associates, 2002